Being There: Capturing and Experiencing a Sense of Place

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Symposium on Computational Photography and Video

Early art: events
Lascaux

Bayeux Tapestries

Renaissance art: events
Da Vinci

Baroque art: portraits
Rembrandt
Photography: landscapes

Ansel Adams

Galen Rowell

Photography: landscapes

Art Wolfe

Interactive Visual Media

• **Games**
  – problem solving, skill acquisition
  – sense of place, navigation

Real-world “immersive” media

• Recapturing the sense of place
• QTVR: the first real breakthrough in modeling from reality?
  
  • Fairly universal for high-end home and car sales, virtual tourism
  • Limitations: mostly static, discrete jumps

Increasing realism

• **Better:**
  – field of view and resolution
    *Demo:* Space Needle
  – dynamic range
  
• Additional cues/modalities:
  – motion / movement
    *Demo:* Deception Falls
  – sound
VR Tools

Fully automated stitch discovery

Image stitching — open issues

- Fully automated assembly (no ordering)
- Full 2D stitching (multiple rows)
- Double image fix-up (de-ghosting)
- Merging different exposures
- Automated grouping/clustering (detection)

HDR: merging exposures

Inputs

Tonemapped output: no motion compensation or consistency check

HDR: merging exposures

Inputs

Tonemapped output: global+local motion compensation

Video Textures

- How can we turn a short video clip into continuous video?
  - Enhance sense of liveness
  - Use in games and presentations
Video Textures

1. Find cyclic structure in the video
2. Play frames with random shuffle
3. Optional region-based analysis
4. Smooth over discontinuities (morph)

Animating Stills

• What if we only have a single beautiful photo (or painting)?
• Can we add some liveness to a photo/still?

Increasing “immersion”

• Add continuous movement

Animating Pictures with Stochastic Motion Textures

Demo
Bellevue Botanical Garden

Demo
HDR Home Walkthrough
Video-based walkthroughs

- Add continuous movement
- How did we do this?
- Is this 3D? 2D? Graphics? Video?
- Dimensionality and storage?

Limits of Video-Based Walkthroughs

- Video-based walkthroughs are “rail experiences” of a space-time slice
- How do we break the bounds?
  - Can’t move from side to side
  - If there is motion in the scene, don’t see it
- Capturing all points of view everywhere in space at all times is impractical

A Practical 3D Video Camera

- Working volume?
  - Walls of a room: Virtualized Reality
  - 2D “window”: LightField Array
  - 1D “rail”: Virtual Viewpoint Video

“3D” video

Massive Arabesque

Virtual Viewpoint Video

Capture multiple synchronized video streams

Key to view interpolation: Geometry

Stereo

Image 1
Camera 1

Virtual Camera

Image 2
Camera 2
Don’t match pixels – match segments
- Segments contain more information, so they’re easier to match.

Iteratively update depths

Depth through time:

Matting

Find matting information:
1. Find boundary strips using depth.
2. Within boundary strips compute the color and depths of the foreground and background object.

Why matting is important
Real-time viewpoint control

*Matrix*-like effects – on demand!

(With much, much less hardware.)

Light Field Rendering

• Sample and synthesize (capture and render) from a 4D ray space [Lightfield, Levoy & Hanrahan; Lumigraph, Gortler et al., SIGGRAPH’96]

Slow Glass

• What if we could capture all the photons and play them all back at a later time?

Light of Other Days
Bob Shaw, © 1969
http://www.scifi.com/scifiction/classics/classics_archive/shaw/shaw1.htm
Slow Glass

One could stand the glass beside, say, a woodland lake until the scene emerged, perhaps a year later. If the glass was then removed and installed in a dismal city flat, the flat would itself that year appear to overlook the woodland lake. During the year it wouldn't be merely a very realistic but still fictive—the water would ripple in sunlight, silent animals would come to drink, birds would cross the sky, night would follow day, seasons would follow seasons.

Apart from its stupendous novelty value, the commercial success of slow glass was founded on the fact that having a scene was the exact emotional equivalent of owning land. The meanest cave dweller could look out on misty parks—and who was to say they weren’t his? A man who really owns tailored gardens and estates doesn’t spend his time proving his ownership by crawling on his ground, feeling, smelling, tasting it. All he receives from the land are light patterns...

Being There

• Artists (and all of us) have always wanted to capture a sense of being there.
• Computational photography and video bring us a lot closer:
  – realism (field of view, resolution, contrast)
  – movement and sound
  – immersion and exploration
• What does the future hold?